4 January 1967

STEREO COMPARATOR

[redacted] IN.773B

STATINTL

1. Over-All Statement of Work.
2. List of Tasks and Activities.
3. Task Breakdown (Statement of Work).
4. Procurement Specification, Optical System.
5. Estimate Sheets.
6. Pert Phase 1.

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[redacted]

TECHNICAL DIRECTOR
PROGRAM MANAGER
CONTRACT ADMINS.
VP TREAS. — [redacted]
CORP. CONTROLLER
SEN. MECH. ENGR.
GENERAL MANAGER
MANGER NASH. SALES OFFICE

STATINTL

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12-19-66

[redacted]

STATINTL

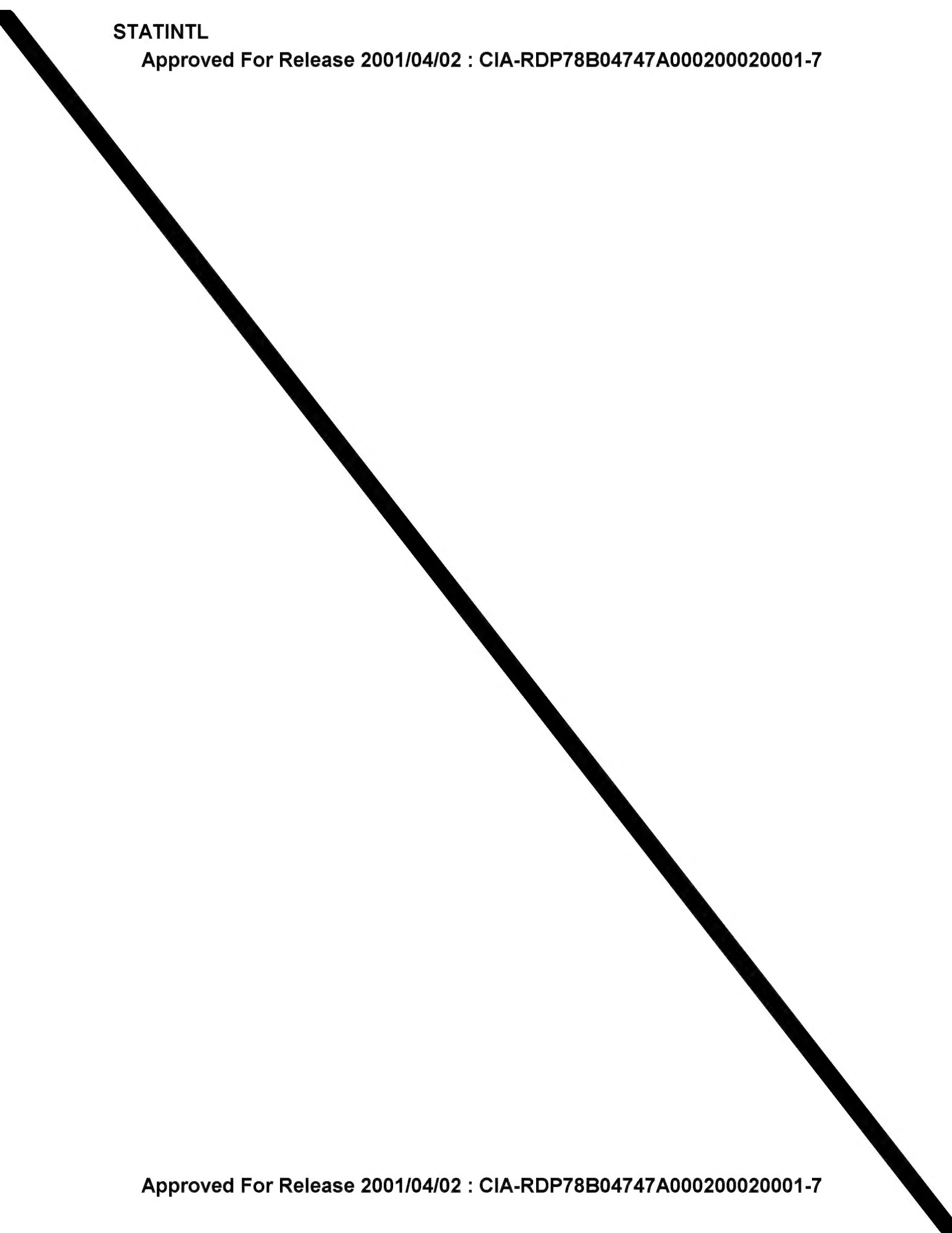
TASKS

1. Statements of work, specifications; Report preparation
2. Scheduling & Planning
3. Test & Inspection procedures
4. Management, Administration & Supervision
5. Meetings
7. Main Frame & Structural Elements
8. Skin
9. Granite & ways assembly for stages
10. Air Bearings
11. Stage Drives
12. Film Drive & transport system
13. Film Platen & film clamping
14. Film Cooling
15. Optical Survey & specifications
16. Viewing optics
17. Viewing Illumination
18. Reticle projector & Illumination
19. Point Finder projector & Illumination
20. General Platen Illumination
21. Optical Bridge & Supports
22. Interferometer assembly
23. Optics Drive Assembly
24. Scanning Device
25. Correlation logic
26. Digitizing logic sub assembly
27. Metric Readout
28. Output logic & Interfaces
29. Cabling
30. Control console
31. Viewing monitors
32. Computer console
33. Electronic Racks & control cabinets
34. Utilities, Vacuum & air systems
35. Vibration absorption & leveling
36. Overall assembly
37. Radio Frequency noise supression
38. Environmental control

39. Reliability Analysis
40. Installation
41. Stereo comparator mockup
42. Breadboards & Test Services
43. Computer programming & services
44. Preacceptance test in fabrication plant
45. Acceptance test in fabrication plant
46. Acceptance test after installation
47. Instruction manual & drawing submittal
48. Spare parts list
49. Operator training

ACTIVITIES

1. Mechanical Engineering
2. Electronic Engineering
3. Optical Engineering
4. Human Engineering
5. Field Engineering
6. Mechanical Design Drafting
7. Electronic Design Drafting
8. Mechanical Detail Drafting
9. Electronic Detail Drafting
10. Checking Drawings
11. Consulting
12. Contract Labor
13. Technical writing
14. Mechanical Fabrication
15. Electronic Fabrication
16. Mechanical Assembly
17. Electronic Assembly
18. Optical Assembly
19. Engineering Testing
20. Manufacturing Testing
21. Rework
22. Mechanical Purchased parts
23. Electronic Purcahsed parts
24. Mechanical Raw material
25. Electronic Raw material
26. Travel
27. Coordination



16 December 1966

STEREO COMPARATOR

OVERALL STATEMENT OF WORK

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Scope

[redacted] will conduct a program whose objective is the Design and Fabrication of an operating prototype High Precision Stereo Comparator.

Design Objective

The Design specifications include applicable references contained in the following documents:

1. Design Objective dated 12 Feb. 1966.
2. Attachment A, as modified by meetings of 18 October 1966 and 17 November 1966.
3. Specification No. DB-1001, Revision 2, dated 11 June 1966.
4. The Final Report on Contract [redacted] Phase I, Design Study, dated 22 December 1965. STATINTL STATINTL
5. Stereo Comparator Proposal, [redacted] No. IN 773, dated 3 March 1966. STATINTL
6. Stereo Comparator Proposal, [redacted] IN 773A, dated 5 November 1966.

7. Statements of Work detailed by tasks, [redacted] No. IN 773B, dated 30 December 1966.

Program

The Program is developed in two discrete phases.

Phase I. The objective of this phase is the preparation of [redacted] shop drawings for the Stereo Comparator. The work envisioned includes:

1. The necessary development and design engineering.
2. The preparation of design and performance specifications.
3. The fabrication and testing of breadboards.
4. The fabrication of a Stereo Comparator mockup.
5. The preparation of drawings.
6. The preparation of reports.
7. The assembly of technical data.
8. The preparation of specifications for government furnished equipment.
9. The preparation of specifications for subcontracts.
10. The supervision of [redacted] consultants.
11. The supervision of [redacted] subcontractors.
12. The management effort for the program.

Phase II. The objective of this phase is the production of the Stereo Comparator. The work envisioned includes:

1. The necessary procurement of raw materials.
2. The fabrication of parts.
3. The selection of vendors and the procurement of components.

Phase II (contd)

4. The assembly of the Stereo Comparator. STATINTL

5. The supervision of [redacted] consultants.

6. The supervision of [redacted] subcontractors

7. The testing of subassemblies.

8. The performance testing of the Stereo Comparator.

9. The installation of the Stereo Comparator at the customer's site.

13. ~~20.~~ The pre-delivery acceptance testing of the Stereo Comparator.

11. The updating of drawings.

12. The preparation of reports. STATINTL

10. ~~19.~~ The conduct of acceptance tests at [redacted]

STATINTL [redacted] subcontractor plants.

14. The preparation of manuals.

15. The management effort for the program.

Deliverable Items STATINTL

Phase I. 1. Two blue line copies of the [redacted] & specifications shop drawings for the Stereo Comparator.

2. One report each month per specification No. DB-1001 covering the management, cost progress and status of the stereo comparator project.

3. Copy of all reports from sub contractors and consultants.

4. Original of optical design and ray traces.

5. Original of correlation subsystem design

6. Final Report incorporating all subsystems into one integrated stereo comparator.

Phase II.

1. One operating prototype high precision Stereo Comparator.
2. One acceptance test with five copies of the report per the approved test plan to be performed at the [redacted] plant with [redacted] personnel.
3. One installation and checkout of the prototype high precision Stereo Comparator system at the customer's site. Note: The customer will provide the special photographic imagery, etc., for the acceptance testing, and will perform the tests.
4. One report in five copies of the preliminary draft of the final performance test plan.
5. One report in five copies of the final performance test plan as approved by the Technical Representative of the Contracting Officer.
6. One operating instruction manual in five copies.
7. One programming instruction manual in five copies.
8. One maintenance instruction manual in five copies.
9. One recommended spare parts list in five copies.
10. Two blue line copies of any updated or otherwise revised to "as built" [redacted] shop drawings & Spec. for the Stereo Comparator.
11. One report each month per specifications No. DB-1001 covering the management, cost progress and status of the Stereo Comparator Project.

Note: All reports specified above will be supplied as follows:

a. Two copies will be provided for the Contracting Officer.

b. ~~Three~~ FOUR copies will be provided for the Technical Representative of the Contracting Officer.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-7 Main Frame and Structural Elements

From work accomplished on the Stereo Comparator mockup and the Granite base design, dimensions and loadings of the main frame may be found.

The main frame will be designed to support the 2 Granite bases each on 3 point suspension. The main frame will in turn be supported by a vibration isolator leveling system.

The main frame will be designed so that thermal expansion will cause minimum deflections in the direction perpendicular to the longitudinal separation of the two Granite bases.

Regidity parallel to this direction should be very high.

Coordination with vibration isolation design is required.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-8

Skin

The skin will consist primarily of removable panels surrounding the base of the Stereo Comparator plus removable covers on the optical bridge protecting the optical train. The base panels will be dimensioned during main frame design.

The optical bridge covers will be correlated with the optical bridge design and the optics packages.

The skin and cover material will be painted aluminum sheet, fasteners and trim will be considered for corrosion resistance.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-9 Granite and Ways for Stages

The design must be coordinated with all mountable components, i.e., air bearings, drives, film transport, laser interferometer, etc., for determination of flatness, perpendicularity and parallelism tolerances, space requirements, and requirements of mounting holes and brackets. Design goals for flatness of bearing surfaces and ways will be 50 millionths of an inch, also bearing way straightness and orthogonality better than 2 seconds of arc (9.7×10^{-6} radians).

The pitch, roll and yaw of the top stage must not produce a combined tilt error greater than 1 second of arc on any axis within the operating area of 10" x 24".

Upon the completion of preliminary design a single system of base, stages and ways will be fabricated and assembled into an operating entity (e.g., a breadboard of one half of the Stereo Comparator system). This equipment will be used for testing the air bearings, stage drive, interferometer, etc., and their associated electronics and control systems.

On the completion of testing, a detail design for the dual stage system for the Stereo Comparator will be completed.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-10

Air Bearings for Stages

The preliminary design, fabrication, and testing of air bearings applicable to the Stereo Comparator high precision stages and drives will be performed prior to detailed design.

The above testing work will be in conjunction with the stages and drives experimental testing.

The design goal for the bearing stiffness will be 4 pounds force per square inch of bearing surface, per micron of bearing gap deflection.

Should the stages require load compensated bearings, then a suitable load compensating device, for each bearing, might consist of sensors which typically might consist of gap sensors, differential pressure sensors, load sensors, flow sensors, or combinations of these or other types of sensors, to sense the change in lift off gap. Then a means of transmitting this information into a pressure and/or flow increase or decrease to maintain the lift off and stiffness gap to within the tolerance. Note that any air flow noise must be minimized.

The main loads that will be encountered will be the accelerating and decelerating loads, the translation loads of the masses of the X and Y stages, and the loads due to the film exchange from one spool to the other.

The maximum acceleration and deceleration is estimated at 10 in/sec^2 and the weight is estimated at 700 lbs.

The film exchange load will change from 0 lbs., empty spool to approximately 20 lbs. full spool of 9-1/2" wide, 500' roll film.

After successful development and testing of the air bearing, a detail design will be accomplished, applying the air bearings directly to the Stereo Comparator stages as required.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-11

Stage Drives

The preliminary design, fabrication, and testing of stage drives for the 'X' and 'Y' axis stage of the Stereo Comparator will be undertaken prior to detail design.

The drive testing will be in conjunction with the air bearing tests.

The drives shall be highly responsive, repeatable, non slip, reliable (without backlash or overshoot) devices, and shall not constrain the air bearings lift off.

The drives shall be bidirectional with speed continuously variable from 0.001 in/sec to 3 in/sec and with repeatability within 1/2 micron. These parameters shall be used as design goals.

The drives shall be non slip under maximum acceleration and deceleration of 10 in/sec^2 with a total weight of 700 lbs.

The stage drives typically may consist of a driven bar attached to the stage to be moved, and a single drive wheel pressured to the driven bar which is backed by an adjustable idler to control pressure, or a dual set of pressured drive wheels if required for torque. Combinations of these, or other types, will be considered.

The stage drive controls shall provide the capacity for:

1. One common control for all 4 axes.
2. Control for both axes of either stage.
3. Independent control of each axis.

Upon the successful completion of the drive testing the detailed drive design will be accomplished.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-12

Film Transport System

Detail the design of the film transport system for the Stereo Comparator. Each film transport system is to be independent and identical.

The film transport system will be designed utilizing known and proven [redacted] systems or combinations of systems as required.

STAT INTL

Wind emulsion in or out

The film transport system will have a continuously variable, bidirectional, slew rate of from 2.5 ft/min to 250 ft/min. The film will be capstan driven. The system shall be designed to insure that workable film tension is maintained throughout the slew rate limits, and that protection from abrasions, scratches and tearing is assured. A radius arm sensor is contemplated as the input to the tension circuitry.

The film transport system will handle roll film which varies in widths from 70 mm to 9-1/2 inches and up to 500 foot rolls with thickness of from .002 to .007 inches - and should be capable of size changeover within two minutes. The film transport system will be supported on the main film stage. The film may be emulsion up or down and the system must handle film wound emulsion in or out.

The film motion will be controlled by a single axis joystick, mounted on the control console nearest to the film it controls. The joystick will be spring loaded for automatic return to its center (neutral) position.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-13 Film Platen and Film Clamping System

The preliminary design, fabrication, and testing of a film platen and film clamping system for the Stereo Comparator will be undertaken. Each platen will be 10" x 20" and will accommodate formats varying from 70 mm ~~square~~ to 9-1/2" x 20". The hold down system shall not degrade the image as seen through the optical system.

The film hold down system must accommodate cut chip film ~~and film plates~~, as well as roll film. Size adjustment for different formats should be accomplished (as a design goal) within two minutes.

When the film is clamped to the stage, it must remain flat so that the entire format is in focus at all magnification settings. Consideration will be given to an air puck hold down. emulsion up or down

The hold down or clamping of the film should be accomplished (as a design goal) within 10 seconds. Furthermore, after the roll film is properly loaded, the clamping, unclamping, transporting, and reclamping operations should be interlocked for automatic operation.

The further specification of readability through the viewing optics of the film "tic" marks, approximately .070 inches in from the edge of the film, must be considered.

STATINTL

The clamping means suggested are either vacuum, utilizing proven [redacted] designs, or by electrostatic devices or combinations of these. positive pressure

Upon the completion of successful testing the detailed design will be accomplished.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-14

Film Cooling

Experimental development and testing of methods to maintain film at temperatures below the damage and creep point while being exposed to the heat developed by the Stereo Comparator illumination source, will be undertaken.

The air puck being developed as a means of film hold down at the viewing point may also be a source of film cooling.

Heat filters and other methods short of liquid a gate should be investigated to obtain maximum cooling with minimum light loss.

After successful testing, the detail design to incorporate the film cooling into the Stereo Comparator assembly will be accomplished.

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30 December 1966

Stereo Comparator

Statement of Work

Job 297-15 Optical Survey and Specifications

The preliminary optical procurement specifications will be prepared, including viewing optics, reticle projector, and illumination optics.

These specifications will be submitted to prospective optical ventors. Subsequently, selected vendors will be visited for specification review, specification updating and vendor facility inspection.

Upon the completion of the optical survey and review by the optical consultants, the optical procurement specifications will be finalized.

These final specifications will be sent to the selected vendors in order to solicit quotations for the optical design subcontract.

Note: See "Stereo Comparator procurement specification - Optical System."

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30 December 1966

Stereo Comparator

Statement of Work

Job 297-16

Viewing Optics

After evaluation of the optical subcontract quotations, a design subcontract will be awarded. STATINTL

STATINTL

The design effort will be coordinated by [redacted]

The optical work will include any bench testing required for STATINTL proving the design parameters and will be subject to review and approval by the optical consultants, and [redacted] and the government.

Upon approval of the test data and review of the preliminary design, the detailed design will be accomplished.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-17 Illumination Optics

After evaluation of the optical subcontract quotations, a design subcontract will be awarded.

STATINTL

STATINTL

The design effort will be coordinated by [redacted]

The optical work will include any bench testing required for proving the design parameters and will be subject to review and approval by the optical consultants, and [redacted] and the Government.

STATINTL

Upon approval of the test data and review of the preliminary design, the detailed design will be accomplished.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-18 Reticle Projector and Illumination

After evaluation of the optical subcontract quotations, a design subcontract will be awarded.

STATINTL

STATINTL

The design effort will be coordinated by [redacted]

[redacted]

The optical work will include any bench testing required for proving the design parameters and will be subject to review and approval by the optical consultants, and [redacted] and the government

STATINTL

Upon approval of the test data and review of the preliminary design, the detailed design will be accomplished.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-19

Point Finder

Detail the design of a point finder for each stage of the Stereo Comparator.

The point finder is used for rough location of a point of interest on the film. The coordinates of the point will be stored in the computer for future recall. Upon recall, the point will position directly under the viewing optics objective.

The point finder will indicate an area approximately 1/4 inch in diameter on the film, to be visible to the operator, and at a known fixed distance from the viewing optics objective. The stage travel in the long dimension (towards the operator console) must be sufficient so that the rear end of the film platen may be moved forward of the optics bridge for unobstructed direct viewing during alignment with the point finder reticle.

Coordination with the film transport, the stage drive and the computer logic will be maintained.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-20 General Platen Illumination

Design a means of back lighting the film so that the operator may visually scan the photograph.

The general illumination should cover an area of 10" x 20".

Suggested designs would include cold cathode discharge tubes, phosphorescent coating of platen glass, electroluminescent panels, or other methods available.

The development should consider operator convenience, variable light level and ability to view 3.0 density film (estimate ~~2000 ft.~~ 2400 ft. of adequately between continously 50% to 100% full intensity without visible flicker.) as a design goal, heat dissipation, electrical problems, subjective viewing qualities and physical space available under platen, for all positions of the stage. The main illumination and optics requirements must be considered also. (Without visible flicker)

Less than 20% variance in illumination over the entire surface.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-21 Optical Bridge and Supports

The optical bridge and supports design must be coordinated with the viewing optics package design, the main frame design, the base granite design, and film platen design.

The optical bridge and supports must provide a means of mounting the optics packages, controls and servo drives. They must also be designed to attach to mating members so that the relative motion between the objective lens, housed in the optical bridge, and the film platen on which the measurements are taken is controlled to within the specifications of the stage drive repeatability.

The location of this bridge is to be such that the objective lens is at the center of the stage travel along the 10" (short) axis, and 10" forward from its most rearward travel along the long axis.

The eyepieces are to be arranged so that the line of sight is 15° below the horizontal (operator looking down).

The above design goal requirements will be compatible with the human engineering information obtained in the Stereo Comparator mockup.

30 December 1966

Stereo Comparator
Statement of Work
Job 297-22 Interferometer Assembly

Preliminary design development and testing of a laser interferometer to measure two axis stage excursions.

The lasers as proposed will be [redacted] Model 11 STATINTL Neon lasers with 100 micro watts output and wavelength of 6328.198 Å in air at 20°C 59% R.H. and 760 mm Hg.
69°F

The interferometer will use the [redacted] principle of STATINTL the light beam into two parts and picking up the fringe pattern at 90° out of phase on two photo detectors. Detection rates will be suitable for speeds up to 3 inches/sec.

The stage excursions are 10" and 20" plus the point finder over travel length which means that the two mirrors mounted on the stages will be at least 10" and of the order of 24" long respectively. The top stage will carry both mirrors. The mirrors will be flat within 0.2 fringes over their full length as a design goal.

The stage mirrors will be set perpendicular to each other to within 1/2 second of arc.

The design goal accuracy of the measuring system is one part in 100,000, ~~minimum accuracy required is one part in 20,000.~~ or 0.5 micron whichever is greater C.P.E.

~~The minimum accuracy for any series of at least 20~~ measurements will be such that the radius of the circle of probable error is not greater than one part in ~~20,000~~ 100,000 or 0.5 micron whichever is ~~greater~~.

After completion of development and testing, the measuring system will be designed for integration into the Stereo Comparator system.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-23

Optics Drive Assembly

The drive circuitry for the optic elements and the stages will be designed for optimum performance.

The angular computer outputs to the buffer storage will be differences of position in digital form. For example, D/A convertors may be used to process to analog form the inputs to drive the servo. Specifically a digital system approach will be used from the computer to the drive system, with optical incremental encoders to provide pulses to count the buffer storage down to zero.

The computer outputs for stage positions will be differences transferred in parallel into binary count-down registers for each axis. Their output will drive the servo until the difference is zero.

~~If possible the optics adjustment will proceed incrementally as a design goal.~~

30 December 1966

Stereo Comparator

Statement of Work

Job 297-24

Scanning Device

The requirements for scanning needs (video pickup devices) are two fold. The primary requirement is as a source of video for the image analysis (correlation) systems. The secondary requirement is as an input to the closed circuit TV monitor system. The optical pickup point is just ahead of the eyepiece - hence the image scanned is essentially that seen by the operator.

The resolution should be as high as practical - consistent with the scanning rate used. Scanning rate should be at least 60 frames per second as a design goal with consideration given to the practicality of 120 frames per second. The video bandwidth should match the space frequencies of the optical image (estimated at 100 to 40000 elements per ~~frame~~ field of view.).

Based upon the above, the type of photo pickup device will be determined (i.e., vidicon or image dissector), and the design of the device (if image dissector) and/or specifications will be defined. Then camera design can proceed (two pickup tubes for each camera), based upon the factors described. The task shall include signal through video amplifier output, ready for correlation inputs. Note that one complete scanning device is required for each optical train.

30 December 1966

Stereo Comparator
Statement of Work
Correlation Logic

Job 297-25

Electronic correlation logic is to be developed which will, as a design goal, implement the concepts of an image analysis system. Video signals from the scanning system will be used as input. Output will be analog signals showing the extent to which the two optical images fail to match in certain defined respects. Bandwidth and signal to noise ratio must be such that image variations, as great as 10% of image size, are effectively analyzed to within 10% of their true value as a design goal.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-26 Digitizing Logic Sub-Assembly

The laser photodetecting head and associated circuitry will be designed and optimized so that maximum tolerance is achieved to light output variations, temperature changes, and noise injection.

The circuit will be designed to have as an input two signals in quadrature from the laser interferometer photo detecting head.

This circuitry must process the sinusoidal output, one cycle of which is a half wavelength because the path that is changing is doubled back on itself. The circuitry must then divide the output by two, electronically, and generate pulses according to the direction of stage travel. These pulses will then be read directly on an up/down counter as quarter wave increments and/or the pulses may be fed into the metric reading counter system, in which case readout will be directly in tenth micron (0.1μ) increments. (See Task 297-27)

These circuits must be designed so as to be as immune from noise as possible.

29 December 1966

Stereo Comparator

Statement of Work

Metric Readout

Job 297-27

A special counting system will be provided for reading out coordinate information in tenths of a micron (0.1μ) increments, on a seven digit display, using [redacted] proprietary techniques and circuitry. Systems shall work with stage slew speeds of up to 3 inches per second without loss of counts. Positive and negative position about zero shall be provided. Zero reset and preset capability will be provided.

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Stereo Comparator

Statement of Work

Job 297-28

Output Logic and Interfaces

The design will provide an all inclusive block diagram showing all inputs and outputs and major functional units.

The block diagram shall also show all interconnections, including cable and connector designations and descriptions.

Further, time charts, state charts, flow charts and any other means shall be used to describe the system operation in pictorial form as simply and completely as possible. This will include interaction and interlocking control between computer, stage drives, optic drives, stage and optics position reading devices (interferometer and encoders) and correlation outputs and inputs, as well as operator controls and manual entry devices.

The output of the machine (coordinate information plus operator commanded indicative data) shall be available either in customer established digital sequential format or in output to Government furnished equipment I.B.M. 526 summary punch.

Stereo Comparator
Statement of Work
Cabling

Job 297-29

Design cabling and specify connectors for electrical interconnection between all of the remote components of the Stereo Comparator complex. Cabling will also include connection to customer supplied 117 volt single phase and/or 208 volt 3 phase 4 wire systems.

Cable design will not be completed as to cable length designation until approval of Stereo Comparator component layout for customer's facility.

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Stereo Comparator

Statement of Work

Control Console

Job 297-30

From work accomplished on the mockup, task #41, the detail design of the control console can be completed. Liaison must be maintained with other design functions such as interface, optical control, correlation, utilities, etc.

Control console design will include but not be limited to the frame and cover panels including control panels, trackballs and/or joystics and/or handwheels, circuits, and all other functional non-standard equipment encompassed by the console proper. All standard components utilized such as switches, lights, pushbuttons, etc. will be specified.

Operator's chair will mount separately from main frame and console frames. It will be adjustable in height ± 2 inches from the seat height of 18 inches.

The control console proper will not be attached to the main frame of the Stereo Comparator nor have any uncontrolled influence on its operation.

The console controls will include but not be limited to:

Joystic for movement of Stereo Model (both stages simultaneously)
Mode Selection Switch
Trackballs, left and right for individual stage positioning
Film slew control - left and right
Focus - left and right
Magnification - left and right
Anamorphic Squeeze Ratio - left and right
Anamorphic Axis Rotation - left and right
Image Rotation - left and right
Image Illumination - left and right (General and High Intensity)
Reticle Illumination - left and right
Reticle Control - left and right
Auxiliary Information Input
Point Finder Store Control
Read Command

~~STAGE REVERSAL~~ ?

30 December 1966

Stereo Comparator
Statement of Work
Viewing Monitors

Job 297-31

Viewing monitors must be specified as to size and location from human engineering considerations and the mockup.

Circuitry must be designed to conform with scanning format of Task 297-24. Components must be obtained to permit scanning format. Vendor consultations and custom designed yoke coils may be necessary. Switching capability will be provided to enable operator to select any of four cameras for either monitor.

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Stereo Comparator

Statment of Work

Job 297-32 Computer Console

Design and layout computer console with proper regard to all necessary controls, good human engineering and an understanding of the control usages. The normal computer cabinet as well as required input - output device must be considered.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-33 Electronic Racks and Control Cabinets

Design and selection of cabinets to house the utilities and control electronics.

Selection of cabinets to be integrated with utilities design, control electronic design, and layout of customer's facility.

Stereo Comparator
Statement of Work

Job 297-34 Utilities, Vacuum and Air Systems

The vacuum and air system design will be coordinated with the air bearings design, film cooling design, film clamp design, the vibration isolator design, film transport design and control console design.

The vacuum and air system lines and machine mounted components must be considered throughout the machine design phase primarily from the standpoint of allowable space.

The design will include complete schematic circuits, actual machine placement drawings where necessary, and component selection.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-35 Vibration Absorption and Leveling

Obtain information regarding vibration frequencies and amplitudes to be absorbed both at final installation site and at assembly and test site. Information pertinent to final installation site will be furnished by customer.

From above information and knowledge of stereo configuration and accuracies required, prepare a set of purchase specifications to fully describe the vibration absorption equipment required for the Stereo Comparator.

The above testing and specification preparation may be carried out in conjunction with a vibration analysis consultant.

The vibration absorption equipment will be designed, manufactured and installed by others.

Means will be provided for leveling the Stereo Comparator at the installation site.

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30 December 1966

Stereo Comparator

Statement of Work

Job 297-36

Overall Assembly

The final machine assembly is part of the Phase II program.

A general plan for the Stereo Comparator final assembly relating the main sub-assembly sequences in their final assembly order will be prepared.

This plan will be time oriented to produce the best scheduling and work program.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-37

R.F. Noise Suppression

During Phase I of the program the individual components and the electrical circuitry will be studied from the point of view of minimizing Radio Frequency Interference through design consideration.

The design goal will be to eliminate information carrying emissions at 150 feet from the instrument. The design study is to be in collaboration with a R.F.I. consultant. No formal report and test program is included in the work of minimizing Radio Frequency interference. It is contemplated that R.F.I. corrective measures will occur during Phase II of the program.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-38

Environmental Control

The customer is to provide the existing environmental control specifications and current test data for the installation site of the Stereo Comparator. Additionally the specifications for any extraneous heat or moisture generating or removing equipment that is contemplated, and an estimate of the maximum number of people to be in the area will be provided.

With this information, and in conjunction with an air conditioning consultant, STATINTL will provide the environmental air conditioning to modulate the existing customer supplied $\pm 5^{\circ}F$ systems to a $\pm 1\text{-}1/2^{\circ}F$ tolerance at critical positions on the Stereo Comparator. Note that no equipment will be provided to absorb or otherwise eliminate corrosive products which may be present in the atmosphere.

A purchase specification for the manufactured air conditioning equipment and a specification for its installation will be prepared.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-39

Reliability Analysis

The life and reliability of the components comprising each sub-assembly will be reviewed, throughout the detailed design, as to their contribution to the overall Stereo Comparator reliability.

Engineering estimates of life to be provided as part of the final report of Phase 1.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-40

Installation

A general plan for the Stereo Comparator machine installation and customer facility installations will be developed as part of Phase II of the program.

The plan will indicate the type of personnel required, the estimated time when their function would begin, the estimated time required to perform their function, materials required for set up, space and facilities considerations, customer furnished personnel, utilities and facilities required, etc.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-41

Stereo Comparator Mockup

Design sketches will be prepared and a full scale wooden mockup of the Stereo Comparator will be built including the main frame and structure, the bases and stages, the optical bridge, and the control console. The design and mockup will be built with consideration of human engineering concepts.

The mockup will be used primarily for human engineering studies and for customer evaluation, together with three dimensional fitting and clearance problems, and for reviewing overall size.

The optical bridge mockup will include a mockup of the optics eyepieces and head rest. The optical bridge will require correlation with the viewing optics design packages.

Completion of this mockup testing will aid in the detail design of the main frame task #7, the optical bridge task #21, the control console task #30, the stages task #9 and #11, and the skin task #8.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-42 Breadboards & Test Devices

The various devices, sub-systems, or systems comprising the Stereo Comparator, will be subjected to electronic and mechanical breadboarding and testing as required to demonstrate the design validity, reliability, produceability, operational function, etc.

Various test devices will be manufactured, purchased, or rented as required to test, measure or document the above breadboard designs.

All breadboarding will be fully described, and the conclusions and tests fully reported before inclusion into the respective design details.

20 December 1966

Stereo Comparator
Statement of Work
Job 297-43 Computer Programming and Services

The computer program will be developed to:

1. Control the settings of the controllable elements in the optical trains.
2. Control the positions of the two axis stages.

Note that the computer program will thus provide "error signals" to continuously maintain an optical presentation of a stereo model for operator viewing.

The program will be designed around the available facts i.e., frame, strip & pan ~~types of~~ photography to be handled, stage speeds, correlation limits, optical elements and control, etc., and will be designed in conjunction with a computer program consultant and outside computer services as required.

STATINTL as ref. [redacted]

30 December 1966

Stereo Comparator

Statement of Work

Job 297-44 Preacceptance Test in Fabrication Plant

During Phase II the Stereo Comparator will be checked out and tested both as sub-assemblies and as a final assembly.

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30 December 1966

Stereo Comparator

Statement of Work

Job 297-45 Acceptance Test in Fabrication Plant

For Phase II an acceptance test procedure will be made and submitted to the customer for approval.

The customer will witness the acceptance tests and supply all special test targets, etc., to perform the tests.

The approved acceptance test procedure will be followed unless proved impractical.

The acceptance test procedure will be updated during the test if necessary and approved as updated.

This approved updated acceptance test will be used for the final acceptance test at the customer's facility after machine installation.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-46 Acceptance Test after Installation

For Phase II the acceptance test after installation will follow exactly the approved updated acceptance test used at the Fabrication Plant.

Successful completion of this approved test denotes customer acceptance of machine.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-47 Instruction Manuals and Drawing Submittal

Five copies of the instruction manual for the Stereo Comparator will be prepared in Phase II of the program.

The manual will include general system description, operation, theory of operation, maintenance and preventive maintenance and computer program.

STATINTL Two prints of [redacted] shop drawings will be submitted to the customer at the conclusion of the design, Phase I.

STATINTL Two prints of [redacted] shop drawings updated to show necessary changes will be submitted to the customer at the conclusion of the fabrication Phase II.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-48

Spare Parts List

All vendors supplying components for the Stereo Comparator will be required to submit a list of recommended spare parts for one years service. This will be stated on the purchase order.

All in-house designs and fabrications will likewise be subjected to a spare parts analysis on the basis of one years service.

From the above, 5 copies of the spare parts list will be formulated and submitted to the customer at the time of machine delivery in Phase II.

30 December 1966

Stereo Comparator

Statement of Work

Job 297-49

Operator Training

Five copies of an operator's training manual will be prepared to aid in training operators for the Stereo Comparator. Machine operation will be demonstrated by [redacted] personnel at the time of machine installation and check out at the customer's facility in Phase II.

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30, December 1966

STEREO COMPARATOR

PROCUREMENT SPECIFICATION

OPTICAL SYSTEM

Job 297-16-17-18

This specification describes a binocular microscope viewing system in which the observer is viewing two separate photographs, which can be a stereo pair. The total length from the eye to its photograph is to be approximately 50 inches or more. The object is to permit stereo viewing of two photographs. The photographs must be separated by at least 30 inches, and must lie in the same horizontal plane. For reasons of film handling, the film plane should be slightly above normal desk height, and the eyepieces at a height suitable for a seated operator. The restrictions determine general arrangement, but it is not necessary to use all right-angle changes in optical axis.

Performance characteristics are as follows:

LAYOUT

View optics: approximately 50 inches from entrance windows

Eyepiece level: approximately 10 inches above entrance window level and with a sight angle 15° below the horizontal.

Construction: Support for the optical packages will be provided by purchaser.

Optical packages will include but not be limited to:

1. Viewing optics package as described
2. Recticle projector packages (2 required)
3. Objective lens packages (2 required)
4. Image rotator packages (2 required)
5. Anamorphic packages (2 required)
6. Illumination optics packages (2 required)

7. Magnification (zoom) packages (2 required)
8. All other required components, i.e., field lenses, mirrors, prisms, etc., will be packaged for ease of installation and support.

All optical packages requiring internal actuation will be furnished with external means for attachment of drive motor as specified.

MAGNIFICATION

From object to eye, continuously variable from 10X to 200X, continuously in focus (closed zoom). Eyepiece magnification approximately 10X.

VIEWING OPTICS

Viewing will be by microscope binocular eyepieces which will provide maximum operator comfort. The angular field of the eyelens station is to be at least 35° and special consideration must be given to eye relief, exit pupil, and field flatness, for ease of viewing. The eyepieces shall be adjustable to include but not be limited to the following adjustments:

1. Adjustable interpupillary distance from 50mm to 75mm.
2. Adjustable headrest.
3. The eyepieces themselves are not to move either vertically or horizontally to accommodate optical adjustments.
4. Axes of eyepiece lenses should be slightly convergent to aid in stereo viewing.

The design shall include optical switching by reversing the eye/object station viewing relationship (left eye to right stage and right eye to left stage), and to provide binocular monoscopic viewing of either the right or left stage, all with minimum light losses. There must be no reversal of the image on switching between left and right eyes - that is, the orientation of the photograph should remain the same for all modes of viewing. In binocular monoscopic viewing, components must be designed that equal light intensity is presented to each eye.

RECTICLE

Provision must be made for introducing a reticle pattern into each optical train before the light passes through the rotator or zoom lens. The prescribed method is to have an objective, immediately above the film, form a first image at about 10X. The reticle will be combined with this image by a beamsplitter above the objective.

1) Functional Description

The reticle image is intended to mark a particular point of interest on a given photograph and also serves as the reference for mensuration procedures between points. Hence, its location is critical with reference to a particular viewed image point regardless of what optical operations are performed on the image by the view system.

More detailed specifications in the following paragraphs are based upon this functional description.

2) Shape

The reticle image shall be a luminous circular dot compensated for the anamorphic correction in the main optical path.

3) Size

The size of the reticle shall be variable, from a diffraction limited minimum to a maximum of 1 millimeter diameter at the eye.

4) Brightness

The luminosity of the reticle image shall be independently controllable to provide satisfactory contrast to the viewed photograph, and to accommodate any apparent variations in luminosity which may ensue from variations in size.

5) Size Coupling

When the reticle image is set for a given size in the eye field, any change in magnification from the zoom setting shall be accompanied by a compensating change in the reticle size. The subtended reticle diameter in the eye field shall remain constant. This requirement implies a coupled variable iris at the appropriate location in the reticle projection path.

RESOLUTION

The image quality available to the operator should, at all magnifications, approximate that of a high performance microscope with respect to: aberration corrections, field size, field flatness, contrast and resolution. The design goal for resolution shall be eight lines per millimeter per power at 10X, decreasing linearly to five lines per millimeter per power at 200X, as presented to the observer. That is, the resolution at 10X setting is 80 lines/mm, and at the 200X setting is 1000 lines/mm.

IMAGE ROTATION

K mirror systems will be included to provide independent and unrestricted image rotation for each image. These K m irrors must be located in regions subsequent to the zoom lenses and in which the light is collimated.

ILLUMINATION

Each optical train will be furnished with an adjustable high intensity illumination source consistent with good optical practices and insuring as a design goal that adequate intensity is available at all magnifications.

Appropriate cooling will be provided as part of the illumination system, to insure that the film will not be degraded by heat. The color temperature of the source shall not fall below 3400^{o}K at any intensity level.

ANAMORPHIC ELEMENT

An adjustable anamorphic system with a squeeze ratio of at least 1:2 shall be incorporated into each optical train. The anamorphic system shall be capable of unrestricted rotation in either direction about its optical axis. This shall be located in a region subsequent to the image rotator and in which the light is collimated.

Each anamorphic system shall consist of two cylindrical lenses with a fixed squeeze ratio (1:1.5 is suggested). The variable ratio will be produced by setting the angle of one cylindrical lens with respect to the other.

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